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Sustainable Development, EU-FP7-HEALTH and Neuroeconomic Management

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Abstract

Background: The present international measures of democratic policies towards the ecological crisis as formalised in the Kyoto Protocol are evaluated as quite insufficient to deal with the core of the problem as indicated by i.e. the comprehensive studies related to our Symposia in Baden-Baden as well as the UNEP/IPCC-simulations. On this background a bottom-up strategy to improve social management/organisation is developed. This strategy is based on new medical scanning technologies as functional magnetic resonance imaging (fMRI) which has enabled the detection of the neural correlates to ordinary decision making in a new interdisciplinary field termed neuroeconomics. This line of research has revealed the voluntary integration of the limbic and neocortical subdivisions of the brain as crucial to human decision making.

Test field: A fairly large segment of modern societies demanding the utmost interdisciplinary coordination to produce significant results is the cross sector rehabilitation of chronic conditions i.e. stroke patients. Supported by the EU-FP7-HEALTH-Programme an international research project between seven EU-members has been established to verify the practical rehabilitation benefits from systematic improvement of the limbic and neocortical subdivisions of the brain. The project is running 2009-2011.

Expected results: It is hypothesized that a systematic improvement of cortical integration by home instead of hospital rehabilitation in patients disabled in average daily life (ADL) i.e. by stroke, heart failure or COPD is a dominant intervention as the long-term economic benefits surmounts the costs.

Conclusion: In case of a positive outcome of the EU-FP7-Homecare project for rehabilitation patients a more general strategy for improved management towards sustainable development by neuroeconomic coaching is outlined in the discussion.

Introduction

A new interdisciplinary field between behavioural economics and neuroscience is emerging as neuroeconomics. This research field uses often functional magnetic resonance imaging (fMRI) which enables the detection of the neural correlates to ordinary decision-making. A neuroeconomic model explains the core of decision-making as the integration of preferences arising from the level of the limbic system (L) with cognition as processed in the prefrontal cortex (PFC) [Larsen, 2008].

The new research framework programme of the European Union gives priority to health issues (EU-FP7-HEALTH). One of more broad health issues are the improvement of the efficiency of delivery of health care to the citizens. A specific topic is continuity of care in the interface between hospitals and social services. Within this topic integrated home care is a dominant intervention which combines improved effectiveness of rehabilitation with economic savings for society [Larsen, 2006].

The effect of integrated home care is explained by better integration of the limbic and neocortical subdivisions of the central nervous system (CNS) during relaxing activities in your own home i.e. is your blood pressure 5-7 mmHg lower when measured in your own home compared to measurements in a medical ward. On this background is the dissemination of integrated home care a broad demonstrator of the benefits of better mental integration as it applies to frequent groups of chronic conditions as stroke, heart failure (HF), chronic obstructive pulmonary disease (COPD) and psychiatric diseases. A majority of the EU populations is exposed to risk of these four chronic conditions.

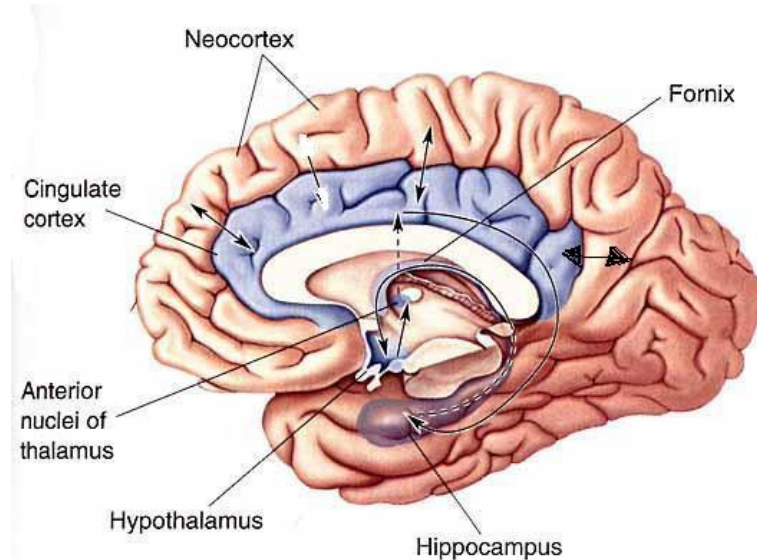
Firstly, the paper summarizes the neuroeconomic model. Secondly, an EU-FP7-HEALTH-project serving as a large-scale dissemination-test is summarized.

A neuroeconomic model

The model reflects four evidenced phylogenetic levels of the biological evolution of the brain:

L1: The *fight-or-flight response* originating in the Reptile brain stem (**RAS**).

L2: Emotions or 'somatic markers' are originated in Papez circuit between Hippocampus, Hypothalamus, Thalamus, Anterior Cingulate Cortex (ACC) and back to Hippocampus. The circuit is modulated with respect to reward experience by mesolimbic dopamine activity and projects by the thalamo-cortico pathways. This Mammalian 'Limbic System' (**L**) includes active centres during



dreaming when the prefrontal cortex sleeps. L serves a *wait-for-reset* modification of the basal fight-or-flight response, see figure 1.

L3: Cognition in the associative cortices relates L to the *semantic recollection centre* (**R**) in Superior Temporal Sulcus by AHA-experiences [Kounios, 2006].

L4: The Executive is a tripartite frontal integration unit *minimizing prediction errors*: ventromedial *voluntary emotional control* (**CONC**) of the orbitofrontal *utility centre* (**U**) enables dorsolateral *sequential analysis* (**A**) of R served by the Intraparietal Sulcus (**I**).

A major finding is that the subdivisions (L1-4) are integrated by two meta-

Figure1. Limbic system (L) and Neocortex.

functions across levels: a bottom-up emotional intelligence (LU) and a frontoparietal-downward logico-matematico intelligence (RIA). The decision making formula approaching zero by learning is:

$$\text{CONC} := \text{LU} - \text{RIA} \rightarrow 0$$

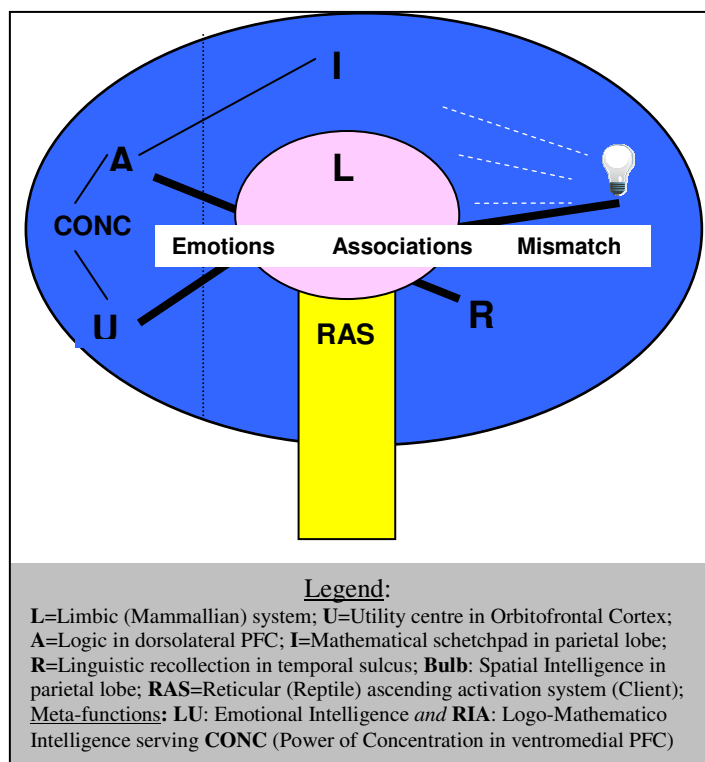


Figure2. Neuroeconomic Flowchart.

The model upgrades the autonomic nervous system (ANS) from a somatic automatism to a primary centre of consciousness in ACC (L) following the lines of research originating from McLean 1972 and Luria 1973, see [Cory and Gardner, 2002].

L interacts in a 3-channel and 2-way communication with the prefrontal CONC, see figure 2. However, the relationship between L and CONC is typical stabilized by negative, defensive instead of positive, evolutionary feedback. The root of the negative character of L-arousal is Amygdala which mobilizes *fear of missing a reward* to be counterbalanced by *fear of making errors* from CONC. The model is validated as a sensitive prototype of a *socioeconomic decision-maker who is biased in favour of immediate instead of long termed solutions* due to a pessimistic mood. A serious barrier against long term planning!

In summary, the discovery of L explains the efficacy of both social and neuropsychological relations:

- 1) The identified parameters of social satisfaction (trust, reputation, equality and participation) explain the effect of human relation management of work groups as discovered by the Hawthorne experiments [Mayo, 1949]. This Hawthorne-effect is rediscovered in healthcare as the dominance of home rehabilitation to hospital rehabilitation [Larsen, 2006].
- 2) De-stressing by medical meditation is explained as a *logical relaxation* enabling *reinforcement of L* elevating the general mood [Arias, 2006].

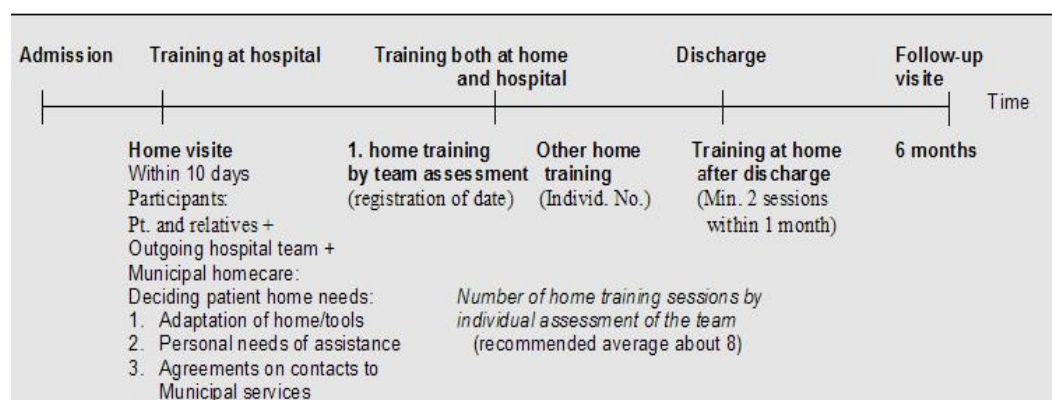
An EU-FP7-HEALTH-project based on neuroeconomics (Homecare no. 222954)

The fragmented delivery of healthcare and social services was put on the agenda as a major problem by WHO in 2002. The relationship between continuity of care for chronic conditions (CC) and quality outcomes relies on the impact of three values (Servellen, 2006, p. 193) of social patient psychology:

- Perceived control over their care (*feeling safe*)
- Great involvement in decision-making (*participation*)
- Knowledge about their illness and its treatment (*primary health feedback*)

Moreover, the three psychological factors stated above seem more relevant to CC where patients have limited capacity of self-care i.e. stroke patients. Half of the studies in clinical continuity focus on the transition from hospital to home care. In all, the action mechanism of IC might be conceived as a human-relations-management effect in healthcare parallel to the *Hawthorne-effect* discovered in industrial work organisation before World War II where the action mechanism is explained by the neuroeconomic model as relaxation of the RIA deliberating LU in a reinforcing process.

Figure 3. Flowchart for Early Home-supported Discharge (EHSD)



The potential outcomes from IC in general and home health interventions in particular focus on ADL more than mortality. Such outcomes i.e. prevention of readmissions or referrals to

institution might be priced in accordance with their savings in health care and social services. Accordingly, cost-effectiveness analysis is an important tool for decision-makers having to set priorities for a variety of alternative IC interventions.

Early home-supported discharge (EHSD) of stroke patients compared with hospital rehabilitation is associated with reduced blood pressure [Verberk et al, 2005] as a neural correlate to the psychological effects listed above. EHSD combines efficacy with net savings representing a prototype of integrated care (IC) or *overlapping services* for better clinical continuity which reaches beyond simple coordination at the management level [Larsen et al, 2006], see Figure 3 with a gradual discharge uniting subjective and objective criteria. Other frequent chronic conditions as heart failure, chronic obstructive pulmonary disease and mental disease exhibit parallel results from home health interventions.

Also, the project organisation reflects neuroeconomic findings as the multidisciplinary collaboration between scholar-teams from 8 different EU-countries subordinates hierarchical control to the common purpose accomplishing a comprehensive health technology assessment (HTA) of IC with maximal individual motivation and minimal restriction on across-relations. This might be characterized as an adaptive matrix organisation. See figure 4-6 for organisation chart and project dissemination strategy.

Figure 4. The Homecare consortium

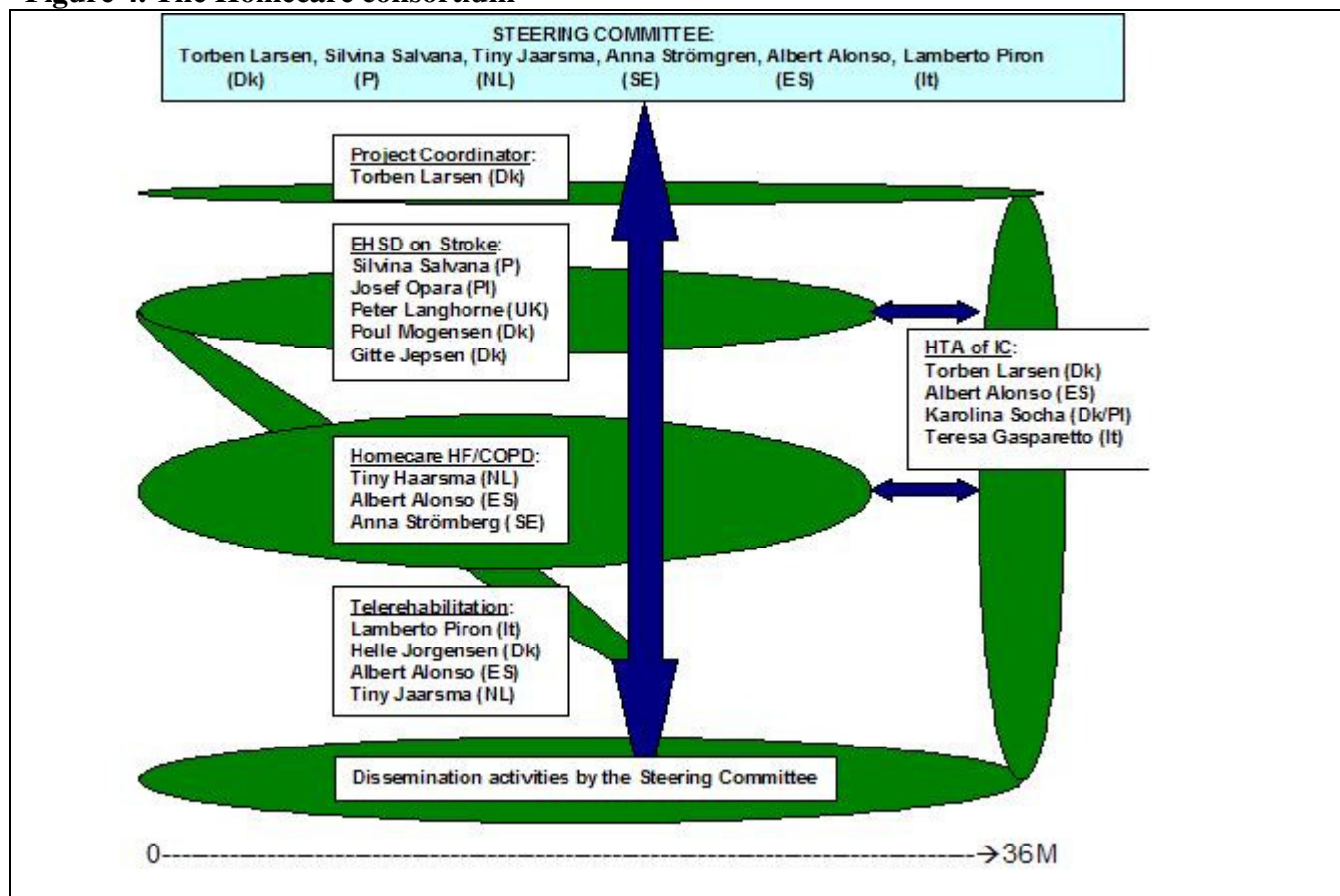


Figure 5. SWOT-analysis of Integrated Care

Strengths <ul style="list-style-type: none"> • Dominant interventions creating synergy • Benefit a majority of the population • Based on a neuropsychological holism shared by more health professions 	Opportunities <ul style="list-style-type: none"> • Job-enrichment to therapists and nurses • Low-Tech-interventions is a special opportunity to middle-income countries • General improvement of organisational quality
Weaknesses <ul style="list-style-type: none"> • Moderate improvements on a day-to-day basis • More RCT-evidence is needed for evaluation • Lack of trust across the secondary-primary interface 	Threats <ul style="list-style-type: none"> • Fragmented financial conditions • Defensive specialist strategies • Mediocre implementations without effect

Figure 6. Summary of a SWOT-based meso strategy on dissemination of IC in EU

1. Research activities completing the evidence-base on IC for practical guides

This part is implemented by a multidisciplinary research team from 7 different EU-countries covering expertise within stroke, HF, COPD, TeleRehab and health economics

2. A synthesis of evidence in the format of an HTA of IC for improved interdisciplinary cooperation across the secondary-primary interface with the modules:

- Assessment of the efficacy of IC based on a systematic literature review and related meta-analysis
- A member-specific query on the organisational and financial conditions of IC in collaboration with EUnetHTA
- A HTA-report presented at an Annual HTAi Meeting and distributed to national health authorities

3. Formation of country-specific multidisciplinary networks on IC for long term dissemination

Such national teams should comprise: physicians, nurses, therapists and health economists. These teams should seek collaboration with health professionals and administrative national organisations as well as relevant NGO for dissemination of IC by solid demo projects. In the long-run modifications of existing organisational arrangements and financial conditions as to facilitate IC might follow.

Discussion

Already, neuroeconomics seems to enrich neuroscience as the rehabilitation of large groups of chronics might be improved implementing general principles of cortical integration moving part of rehabilitation from an autocratic hospital environment to a more supportive home environment. The next step might be to enrich people in general including neuroeconomics in the education of economists as economists are a key group in the decision making process in industrialized countries. On this path a number of management courses based on humanistic psychology as the Mazlow hierarchy of needs do exist [Mazlow, 1968] which is supported by the neuroeconomic model: Basal physiologic needs, needs for security and belonging at L2 and the need for esteem as a regression to L1. Neuroeconomics operates the top level of self-actualization elevating human resource development (HRD) to a transparent and reinforcing level where subjective qualities as empathy (in LU), pragmatism (by RIA) and endurance (integrating LU and RIA) have a clear neural correlate, see table 1. So, HRD might reach the same level of evidence-based science as the different positivistic disciplines to be coordinated.

Table 1. Neuroeconomic Training Programme

Objective	Indicator	Means of training
Empathy	Capacity of association in dialogue	Relaxation, meditation, arts and social activities
Pragmatism	Capacity in mathematical statistics	Education in simple as well as complex positivism (Cybernetics)
Endurance	Capacity to stabilize stressors	Physical fitness by exercise

Conclusion

The present state of reductionist (disciplinary) academic education is insufficient to provide a sustainable international economic growth within the international economic-political system formalised in the Kyoto Protocol. On this background a holistic training approach based on the new discipline of neuroeconomics is tested as research collaboration between scholar-teams from 8 different EU-countries granted by the EU Commission. In case of positive results from this project a training programme for holistic neuroeconomic management training is outlined. Neuroeconomic management training of economists, especially, might provide a future roadmap towards sustainable development.

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